**Fig. 1**

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| Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Eu | Fe | Gd | In | Ir | La | Mn | Ni | ReO | Rh | TlO | Yb | Zn | Avg TON |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|----|-----|----|----|---------|
| 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1802 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1711 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1698 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1671 |
| 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1670 |
| 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1645 |
| 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1645 |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1645 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1645 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1645 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1623 |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1621 |
| 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1614 |
| 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1578 |
| 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1550 |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1539 |
| 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1530 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1521 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1516 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1509 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1506 |

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Fig. 2

| Metal | Electro-negativity | Atomic Radius | Covalent Radius | Ionization Potential | Atomic Ionization Potential | | | | Electron Affinity |
|-------|--------------------|---------------|-----------------|----------------------|-----------------------------|--------|--------|-------|-------------------|
| | | | | | I | II | III | IV | |
| Bi | 1.67 | 1.7 | 1.46 | 7.29 | 7.29 | 16.16 | 25.56 | 45.3 | 0.95 |
| Ca | 1.04 | 1.97 | 1.74 | 6.11 | 6.11 | 11.9 | 50.908 | 67.1 | 0.18 |
| Cd | 1.46 | 1.54 | 1.48 | 9 | 8.99 | 16.91 | 37.48 | NA | NA |
| Ce | 1.06 | 1.81 | 1.65 | 5.53 | 5.47 | 10.85 | 20.2 | 36.72 | NA |
| Co | 1.7 | 1.3 | NA | 7.87 | 7.86 | 17.06 | 33.5 | 51.3 | 0.662 |
| Cr | 1.56 | 1.27 | NA | 6.76 | 6.76 | 16.5 | 30.96 | 49.1 | 0.666 |
| Cs | 0.86 | 2.67 | 2.25 | 3.89 | 3.89 | 25.1 | NA | NA | 0.47 |
| Cu | 1.75 | 1.28 | 1.38 | 7.73 | 7.726 | 20.29 | 36.83 | 55.2 | 1.235 |
| Eu | 1.01 | 2.04 | 1.85 | 5.68 | 5.67 | 11.25 | 24.9 | NA | NA |
| Fe | 1.64 | 0.68 | 0.72 | 7.9 | 7.87 | 16.18 | 30.65 | 54.8 | 0.151 |
| Ga | 1.82 | 1.4 | 1.26 | 6 | 6 | 20.51 | 30.71 | 64 | 0.3 |
| In | 1.49 | 1.66 | 144 | 5.79 | 5.78 | 18.87 | 28.03 | 54 | 0.3 |
| Ir | 1.55 | 1.36 | NA | 9 | 9.1 | NA | NA | NA | 1.565 |
| La | 1.08 | 1.86 | 1.69 | 5.61 | 5.57 | 11.06 | 19.1 | NA | NA |
| Mn | 1.6 | 1.26 | NA | 7.43 | 7.43 | 15.64 | 33.66 | 51.2 | NA |
| Ni | 1.75 | 1.24 | NA | 7.63 | 7.63 | 18.17 | 35.17 | 54.9 | 1.156 |
| Pb | 1.55 | 1.75 | 1.47 | 7.417 | 7.416 | 15.032 | 31.94 | 42.32 | NA |
| Re | 1.46 | 1.37 | NA | 7.87 | 7.9 | NA | NA | NA | 0.15 |
| Rh | 1.45 | 1.34 | NA | 7.46 | 7.46 | 18.08 | 31.06 | NA | 1.137 |
| Ru | 1.42 | 1.33 | NA | 7.37 | 7.37 | 16.76 | 28.47 | NA | 1.05 |
| Sb | 1.82 | 1.5 | 1.38 | 8.641 | 8.64 | 16.53 | 25.3 | 44.2 | NA |
| Sn | 1.72 | 1.5 | 1.41 | 7.344 | 7.34 | 14.63 | 30.5 | 40.7 | NA |
| Ti | 1.32 | 1.45 | 1.36 | 6.82 | 6.82 | 13.58 | 27.49 | 43.26 | 0.079 |
| Yb | 1.06 | 1.93 | 1.7 | 6.22 | 6.25 | 12.17 | 25 | NA | 0.5 |
| Zn | 1.66 | 1.38 | 1.31 | 9.39 | 9.394 | 17.964 | 39.722 | 59.4 | NA |
| Zr | 1.22 | 1.6 | 1.48 | 6.835 | 6.84 | 13.13 | 22.99 | 34.34 | NA |

Fig. 3

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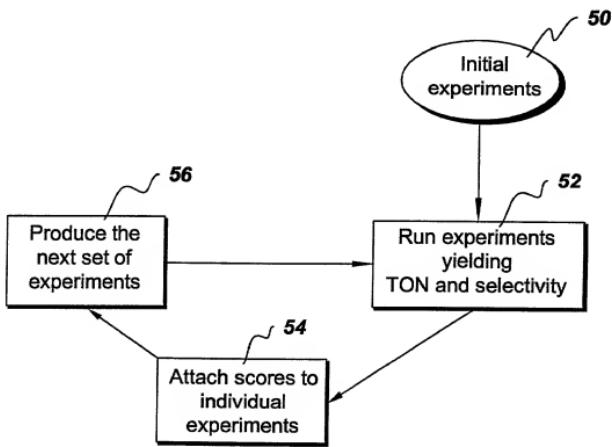


Fig. 4

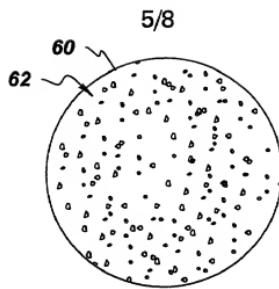


Fig. 5

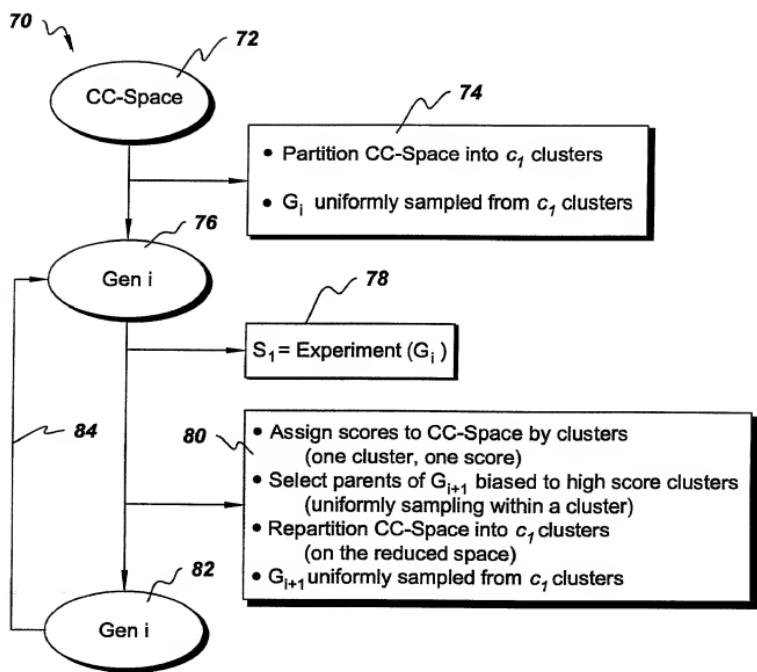
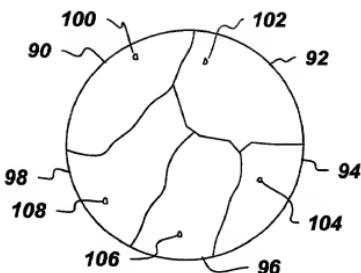
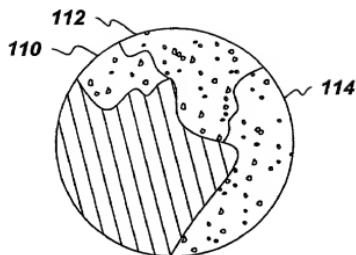
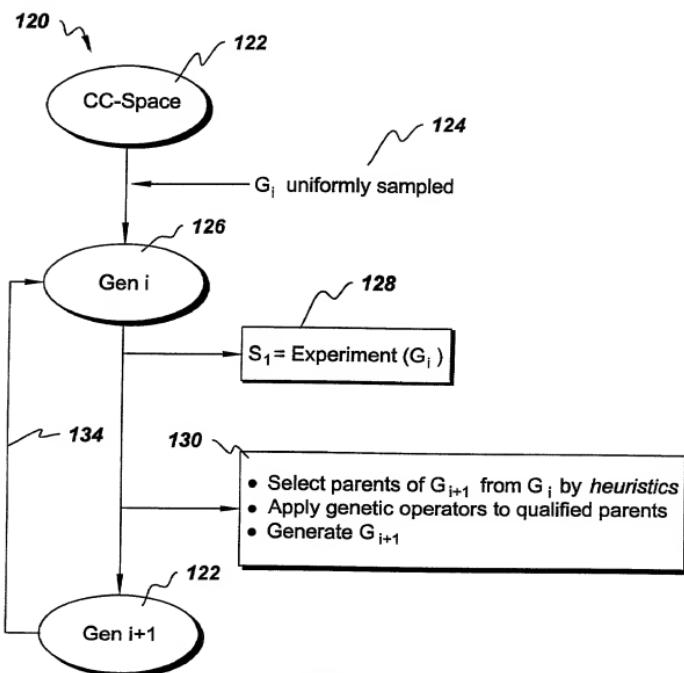
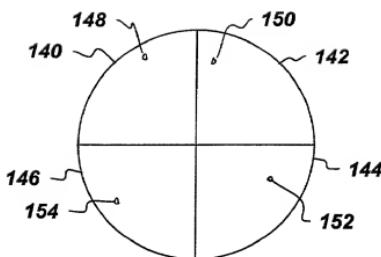


Fig. 6

**Fig. 7****Fig. 8****Fig. 9**

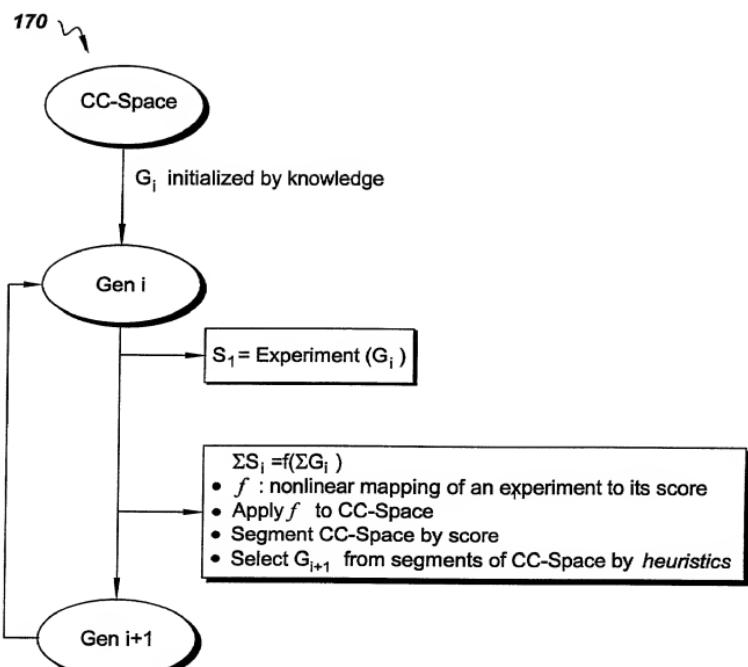
*Fig. 10*

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| | 160 | 162 | | | | | | 164 | |
|-------|-----|-----|----|---|---|---|---|-----|----|
| exp 1 | Ca | Cu | Fe | • | • | • | • | Rh | Yb |
| exp 2 | Cd | Eu | Fe | • | • | • | • | Yb | Zn |
| exp 3 | Gd | Ir | La | • | • | • | • | Ni | Ru |
| • | • | • | • | • | • | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • |

Fig. 11

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**Fig. 12**